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Development of a consistent multi-sensor global ocean colour time series

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Abstract. The advent of a new generation of space-borne ocean colour sensors brings the prospect of global ocean measurements for decades into the future. These measurements will provide the basis for characterizing variability in the structure of the ocean's phytoplanktonic communities and the response of those communities to climatic change. In addition, the measurements will allow development of the scientific basis necessary to manage the sustainable resources of marine ecosystems. These studies will require a merged, long-term, multi-satellite ocean colour time series extending beyond the operational lifetimes of individual instruments. The Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project has been tasked to develop the tools required to create this time series. Among these tools are a comprehensive *in situ* (field collected) bio-optical dataset for validating ocean optics algorithms and associated models of oceanic properties; a programme to evaluate different atmospheric correction techniques; a programme to link the calibrations of individual satellite instruments; a programme to develop consistent calibration and validation datasets for satellite instruments; and a set of alternate methods to combine ocean colour measurements from different sources into a single time series. We report on the progress of this development work by the SIMBIOS Project.

1. SIMBIOS Project overview

The Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project (McClain *et al.* 2002a) has been developed to provide a long-term ocean colour dataset that encompasses the measurements from several satellite instruments. As such, the programme is designed to serve as a bridge between previous, current and future ocean colour missions. The previous missions include the Ocean Color and Temperature Scanner (OCTS) and the Polarization and Directionality of the Earth's Reflectances (POLDER) instrument on ADEOS–I. The current missions include the Modular Optoelectronic Scanner (MOS) on IRIS-P3, the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) onboard

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OrbView2, the Moderate Resolution Imaging Spectroradiometer (MODIS) on Terra, and the Ocean Scanning Multispectral Imager (OSMI) on KOMPSAT. The future missions include MODIS on Aqua, the Medium Resolution Imaging Spectrometer (MERIS) onboard Envisat, and the Global Imager (GLI) and POLDER-II on ADEOS-II. To accomplish this, SIMBIOS has adopted the Marine Optical Buoy (MOBY) ocean platform (Clark *et al.* 1997, 2002) and the SeaWiFS atmospheric correction algorithm as common references for measurements from the different instruments. This approach by SIMBIOS does not preclude other ocean colour reference sites or atmospheric correction procedures. Indeed, it is anticipated that future developments, particularly improvements to atmospheric algorithms, will supercede the current procedures. The MOBY buoy, however, provides an exceptional set of water-leaving radiances for the intercomparison and merger of measurements from instruments on different satellite platforms. These measurements are traceable to the National Institute of Standards and Technology (NIST), the metrology laboratory for the USA, providing a long-term repeatability for the dataset. To date, measurements by OCTS, OSMI, POLDER and SeaWiFS (Eplee *et al.* 2001, Wang *et al.* 2001) have been compared with MOBY to provide a uniform set of ocean colour measurements at a single site. In addition, the SeaWiFS Bio-optical Archive and Storage System (SeaBASS) (Werdell *et al.* 2000, Werdell and Bailey 2002) is used by SIMBIOS to provide a set of *in situ* (field collected) water leaving radiance and chlorophyll-*a* measurements for the validation of satellite ocean colour measurements at locations away from the MOBY site. SeaBASS also includes an extensive set of *in situ* measured aerosol optical thicknesses and other atmospheric parameters to provide a basis for examining and improving current atmospheric correction algorithms. All of these components can be combined using the SeaWiFS Data Analysis System (SeaDAS) (Baith *et al.* 2001), which is in continuing development and is closely linked to the SeaWiFS and SIMBIOS Projects. SeaDAS allows the user to ingest, process and display ocean colour measurements from different satellite sensors. Currently, SeaDAS can work with data from the Coastal Zone Color Scanner (CZCS), OCTS, POLDER, MOS, OSMI, and SeaWiFS and can be used to display MODIS data. Planning is underway for the enhancement of SeaDAS to display data from POLDER-II, GLI and MERIS. In addition, SeaDAS has the capacity to modify a number of atmospheric parameters to provide alternate atmospheric corrections for these measurements. This makes SeaDAS an excellent tool for the testing of upgraded and improved atmospheric correction algorithms.

5. Concluding remarks

The SIMBIOS Project has solicited advice from the IOCCG on the merger of multi-platform ocean colour measurements, including the spatial and temporal resolution of the derived dataset. The IOCCG has been actively involved with the issues surrounding complementary ocean colour missions (IOCCG 1999). It is anticipated that a partnership between the IOCCG and the SIMBIOS Project will lead to a dataset that meets the needs of the international ocean colour community. However, the coordination of a long-term multi-platform ocean colour dataset by the SIMBIOS Project and the IOCCG is a scientific and technological experiment requiring collaboration by the international community. The SIMBIOS Project has developed a set of tools and procedures to initiate such a dataset. However, we recognize that, along with its usefulness, there will also be deficiencies. We anticipate that the improvements to the ocean colour dataset will come from collaborations with our colleagues within – and without of – the SIMBIOS Project. It is a work in progress.